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The Photo Miniature

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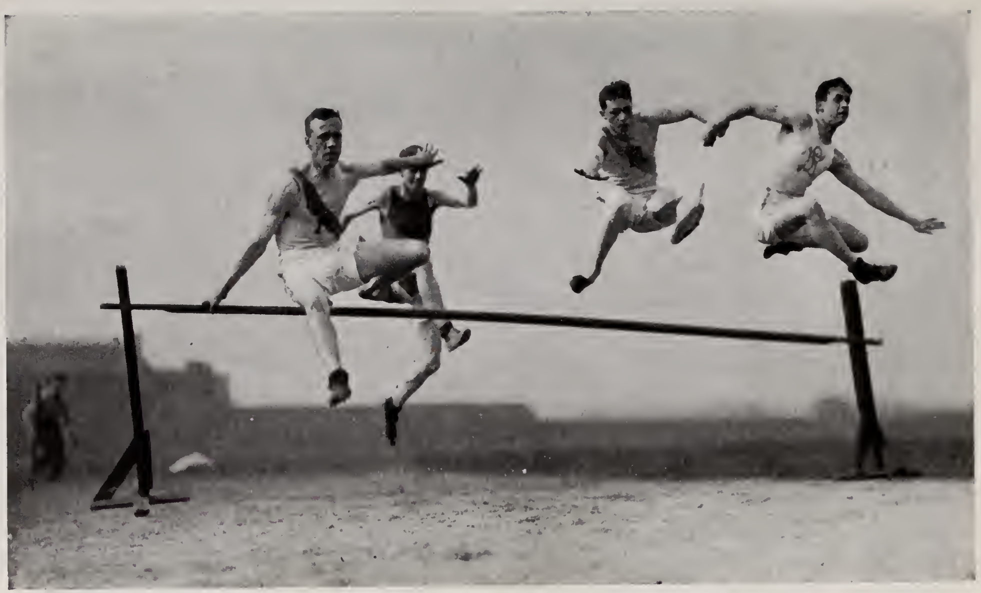
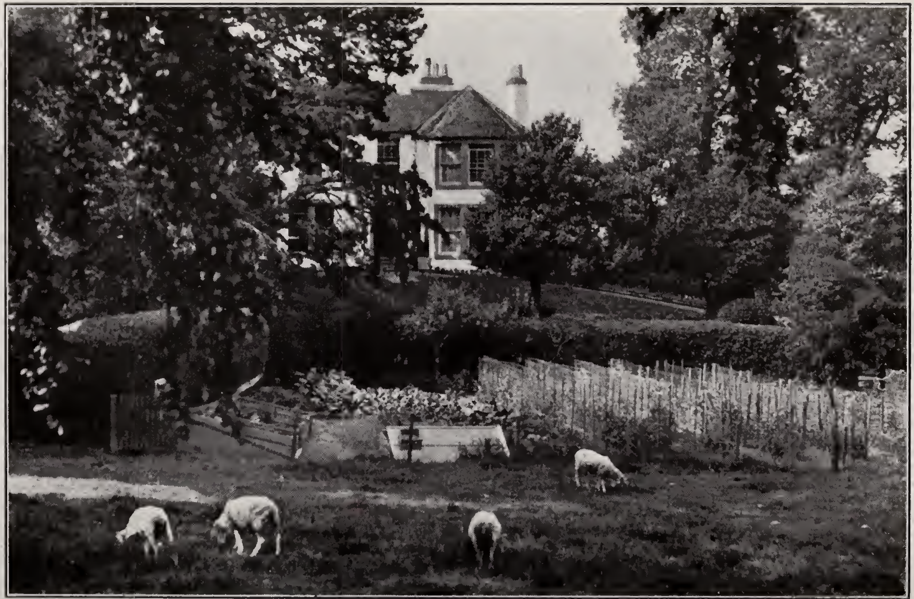
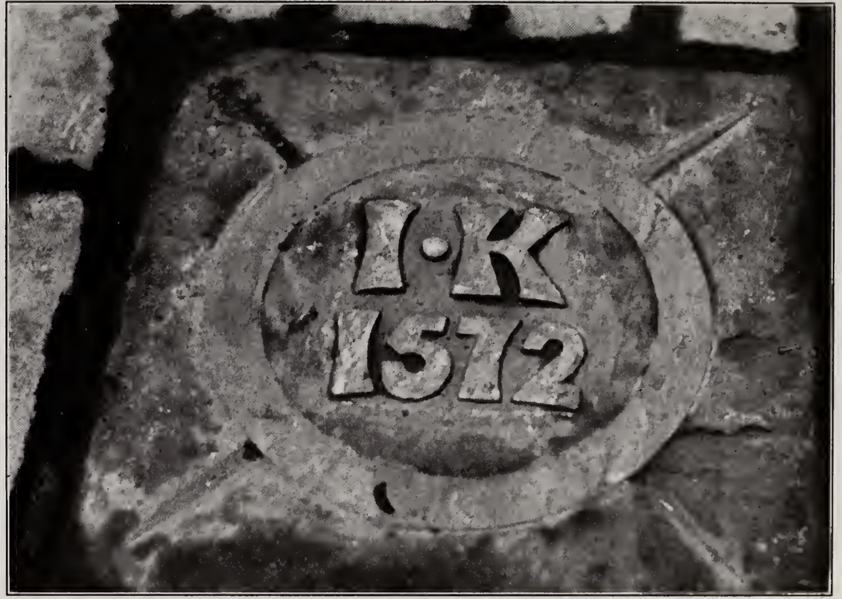


An example of the average "sports" subject where the advantages of reflex camera and focal-plane shutter are obvious. Made with a Graflex



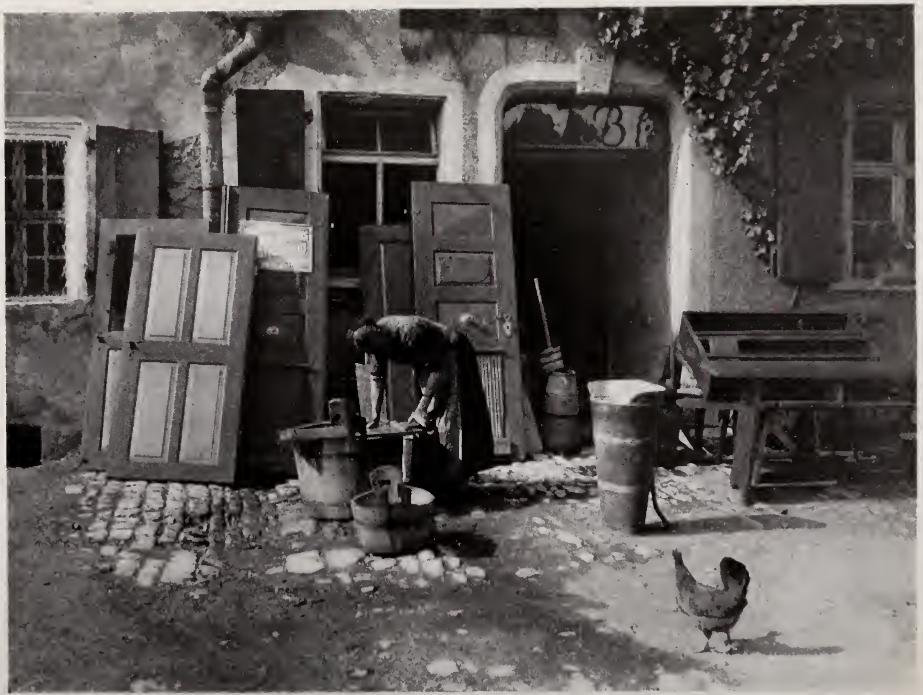
Swanston Cottage, Edinburgh: Home of R. L. Stevenson

From negative made over a hedge with reflex held upside down at arm's length above the head



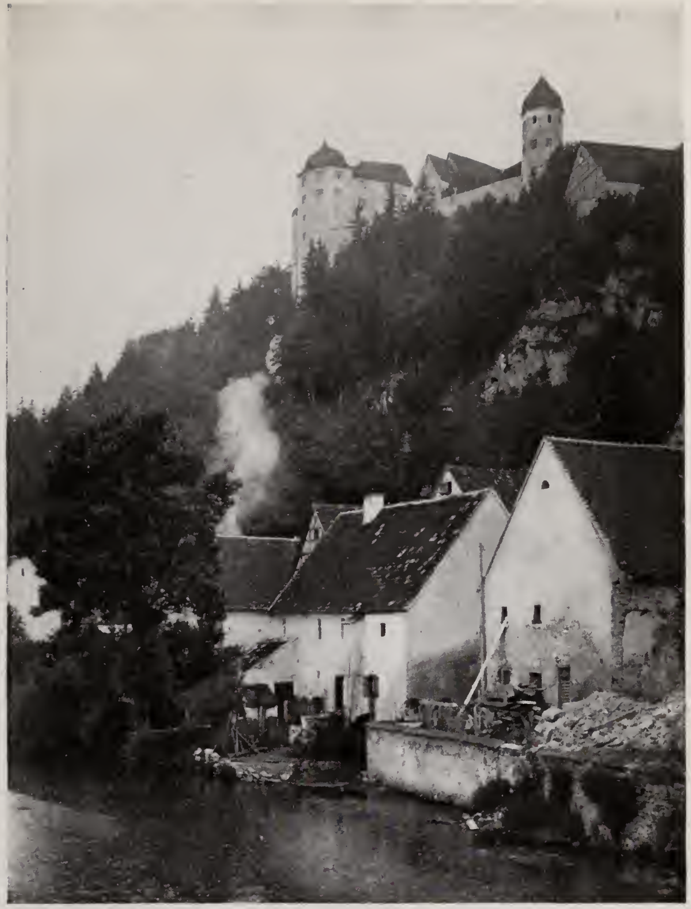
The John Knox Tablet: Edinburgh

Made with reflex pointed down toward the pavement



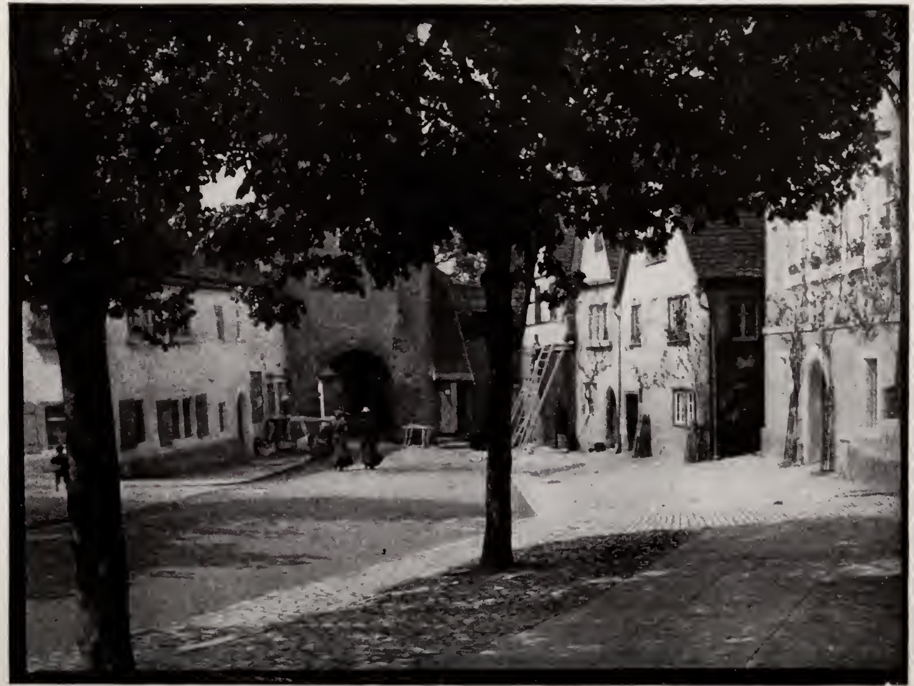
Spring Cleaning

An example of arrangement of picture by rapid glance into hood when using reflex camera at close quarters unknown to the subject



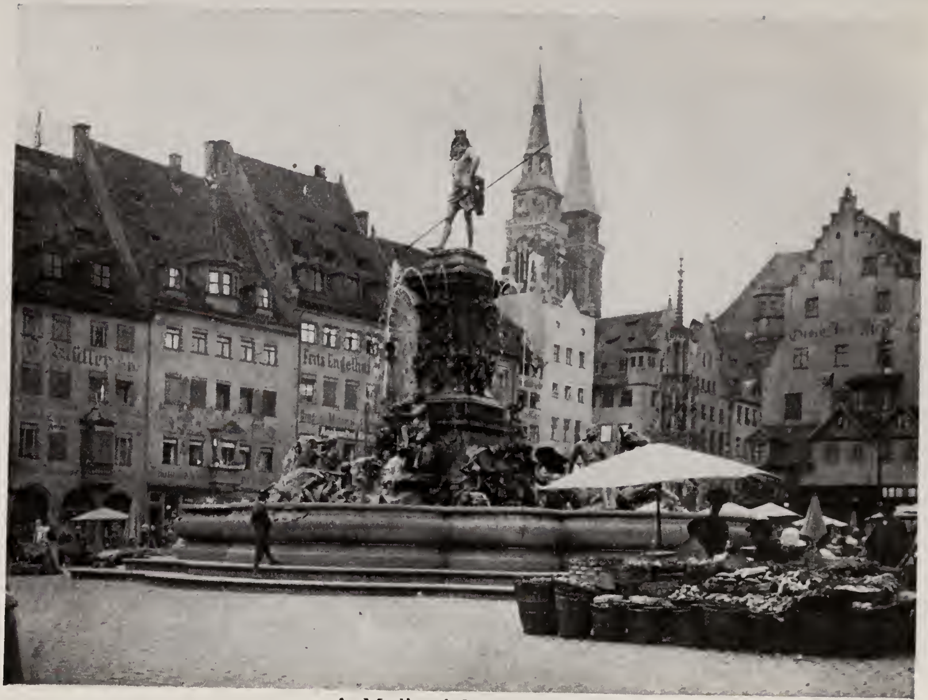
An Ancient Bavarian Stronghold

An example of placing the subject on the plate when the front is raised to full extent



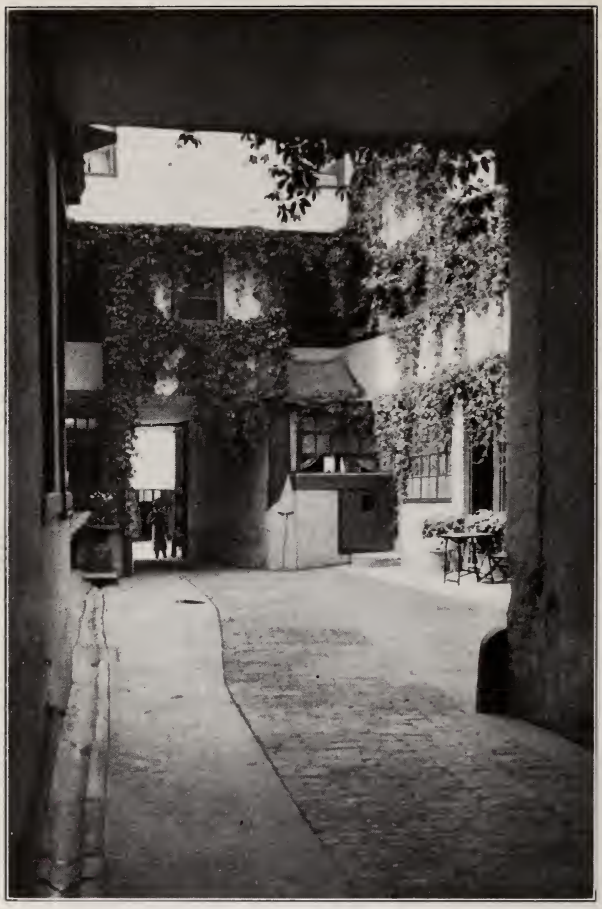
Inside the Castle Gate, Rothenburg, Bavaria

The reproduction shows the reflex negative up to the edges of the plate, the black border being due to the rebate of the plate holder. Example of the nicety of focusing with objects near to and remote from the camera, at an aperture large enough to give full exposure to dark foreground at shutter speed required for moving objects.



A Medieval Market Place

Showing the advantage of the reflex with rising front. A difference of an inch in the position of the lens would have prevented the outline of the Neptune figure being obtained (as here) against the clear sky.



The New Inn: Gloucester
An example of $\frac{1}{10}$ second exposure with reflex

The Photo-Miniature
A Magazine of Photographic Information
EDITED BY JOHN A. TENNANT
Volume XIII JULY, 1916 Number 151

Reflex Camera and Focal-Plane Photography

We photographers, rich and poor, beginners and experts, amateurs and professionals alike, are at bottom animated and controlled by the common desire to get the record wanted, whether pictorial or merely technical in character, and whether for pleasure or wholly a matter of business, in the simplest and surest way. Many of us, perforce, have had to find this simplest and surest way to success by traveling to the bitter end of the hard road of personal experience. The annals of photography abound with the strange adventures of the pioneers who blazed the way, and we wonder at their patience and persistence in the face of difficulties beyond our courage. The photographer of today, however, is twice blessed in this, that he has The Photo-Miniature to tell him of short cuts along this weary way of experience, and the ripe fruit of the experience of those who have gone before him along that way, in the shape of apparatus cunningly devised and perfected for his helping toward success in the making of good photographs.

This number of The Photo-Miniature is, in a very special way, published for those who have eyes to see and ears to hear of this simplest and surest way to success in photography. For it is wholly devoted to the handling of that type of camera which is fitted with a reflecting mirror and a focal-plane exposure shutter which, in a word, is the beginning of the simplest and surest way we seek.

In all photography we have three controlling factors: the finding of the subject, by which is meant getting the subject properly placed on the focusing-screen or finder so that we will get in the negative what the eye sees and desires to record in the subject; focusing the picture image so that it will be agreeably defined, i. e. sharp all over, or modulated in definition by planes or other local emphasis as may be desired, and, finally, the delicate question of exposure. Passing for a moment to hand-camera photography, such as most of us know familiarly, these three all-important factors are seen to be so largely controlled by limitations in apparatus that success is to be attained only by special skill and some experience. The finder is so small that we have many disappointments in failing to find in the negative what we surely saw in the tiny finder. And the right use of such a finder taxes the skill even of an expert. Similarly, in focusing, we are dependent on the use of a tiny scale, to be used with an accurate knowledge of the lens rules on which it is constructed, and the ability to judge distances correctly which comes only from long and severe training. Finally, in the detail of exposure, wherein long experience tells that the surest guide and calculator is the appearance of the picture image on the focusing-screen, we have no focusing-screen and depend on tables and guesses and factors without number, perplexingly related to a lens-shutter speed of which we know only this one thing with certainty, viz., that it is uncertain, unreliable, and variable.

In this brief foreword I have no desire or intention to belittle the ordinary hand-camera. It is, in truth, a wonderful instrument. But its limitations in helping us to control the vital factors of successful negative-making cannot be gainsaid, and have much to do with the discouraging percentage of failures which fall to the lot of the average amateur.

I have said that the reflex camera and its focal-plane shutter is the beginning of the simplest and surest way to success in photography because it eliminates the difficulties inherent to the ordinary hand-camera, and provides us with perfect means of controlling the three vital factors mentioned in the preceding paragraph. Thus the reflex provides a focusing-screen, showing the picture, full size, right way up. With this we can always be certain (1) that the subject we desire will actually be in the negative; (2) that the focus of the picture image is just what we want and is adjustable up to the actual moment of exposure; and (3) we can judge of the exposure needed by learning to estimate the light value of the illumination of the subject on the focusing-screen —as all professionals do. In the focal-plane shutter, as we will see later, we have two desirable helps not found in ordinary hand-camera shutter equipments, viz.: (1) the ability to give the plate or film a maximum amount of light during a given period of time, briefly expressed as light efficiency, and (2) the ability to give exposures sufficiently short to get well-defined images of rapidly moving objects without blur or indication of movement in the resulting picture.

These things being indisputable, it follows that the simplest and surest way to success in photography is to start with a reflex focal-plane camera and learn how to use it. To help the reader to know and use his reflex focal-plane camera intelligently is the purpose of this monograph. It is written by an enthusiast who knows whereof he speaks, and who has already given us practical proof of his right to speak about his hobby in The Photo-Miniature, No. 99: *Reflex Cameras*, published in 1909. Since that time the reflex focal-plane camera has grown in popularity and is today readily obtainable in a variety of sizes and models under many trade names.

Let it be noted here, in the beginning, that the writer of this monograph rightly views and deals with the reflex focal-plane camera as the simplest and surest means of making good photographs of all subjects and upon all occasions (with perhaps the single exception of studio portraiture), and has no sympathy with the commonly prevailing but erroneous notion that this sort of camera is intended only for speed work and press photography. This point of view must be properly appreciated by the reader, otherwise he may be disappointed in finding so much said about everyday work, and so little concerning the photographing of outdoor sports and subjects involving rapid movement. As was clearly pointed out in THE PHOTO-MINIATURE No. 77: *Focal-Plane Photography*, published as long ago as 1907: Focal-plane photography means chiefly a new interest in photography because of the wider possibilities it offers—the lengthening of the photographic day and season, the capacity for successful work earlier in the morning and later in the evening; for dull days and wet days in the early spring and late autumn; for home portraiture, sports, and like subjects of all kinds where the vital thing is maximum light efficiency at the plate or film during the all-too-short exposure necessitated by the subject or the time of photographing. Which wider possibilities are opened up by the simplicity and certainty and efficiency embodied in the reflex focal-plane camera in a larger degree than in any other type of camera available today.—EDITOR.

What is a Reflex Camera?

The reflex is a different kind of camera fitted with a shutter that is different. The two are used in conjunction. Both require knowing if the many special advantages of the combination are to be realized in full. Let it be understood at the outset that the reflex is just as much a camera for the beginner as for the expert photographer who is after the most difficult subjects. In fact a pre-eminent feature of it is that it cuts away at one stroke the two causes of half the failures in the use of a hand-camera, namely wrong focusing and faulty placing of the picture. More than this, it affords special facilities for getting results of quality; of getting them with surprising certainty and in circumstances unfavorable to the use of other kinds of camera.

Its Principles

First a word on the principle of the reflex. Instead of a separate small finder showing a miniature picture of the scene, such as is fitted to the ordinary hand-camera, the actual image to be cast by the lens on the plate is seen, full-size and the right way up, upon a focusing-screen placed in the top of this type of camera. This is done by means of a mirror fitted diagonally in the camera. The rays from the lens are reflected upward from the mirror on to the ground-glass, where the picture can be focused just as though it were formed direct without a mirror at all as in an ordinary view-camera. Meanwhile the plate or film is waiting ready for exposure at the end of the camera, facing the lens but covered by the opaque blind or curtain of the focal-plane shutter, and further shielded by the mirror. For exposure, pressure on a stud or trigger first causes the mirror to swing up into a position underneath the focusing-screen and excluding all light from the camera except that which comes through the lens. Immediately following, the blind of the shutter moves rapidly across the plate, and exposes it for a longer or shorter time according to its speed and the width of an aperture or slit in it. My reader will see at once that a reflex combines the certainty of a view-camera in focusing and choosing the subject on the screen with the speed in operation of any hand-camera.

The Exposure Shutter

The shutter takes its name from the fact that it moves in a surface or plane close to where the picture is brought to a focus on the plate, i. e., the focal-plane. Several advantages attach to a shutter of this kind as distinguished from those working in or on the lens. Exposures can be made very short—of the order of one one-thousandth of a second—by making the blind move very rapidly and having the slit narrow. Also the proportion of the time of exposure during which the plate is fully exposed to the image-bearing rays from the lens is greater than it is with most lens-shutters. This greater "efficiency," as, we shall see later, does in fact vary, but in a large proportion of focal-plane exposures it is greater than with lens-shutters. A third advantage, and one particularly applicable to a reflex camera, is that different lenses of varying focal length and capacity can be used without any trouble, a very big advantage at times. The reflex also offers convenient facilities for the use of color screens when required.

Advantages

So much for the bare outlines of shutter and camera. Let me now turn for a moment to the advantages of a reflex in practical work. The chief of these is the full-size picture seen on the focusing-screen, and seen there infinitely more comfortably than is the image in a view-camera under the focusing-cloth or in the small finder of the ordinary hand-camera. Leaving color out of account, the picture shows exactly what the finished photograph will be like, except that on the ground-glass it is reversed, the right-hand part of the subject on the left and *vice versa*. Next is the facility of focusing the subject or any particular part of it with absolute certainty. With many hand-cameras this is a matter of skill and judgment in the use of a focusing-scale, calling for much practice, and by many people never acquired at all with any approach to certainty or infallibility. With the reflex you do not judge or guess: you see, and the person who has never handled a camera before is almost as certain of sharp negatives as the old hand, accustomed to use an ordinary kind of snapshot camera every day of his life. Further, the reflex is an all-purpose camera, serving efficiently for all kinds of subjects, with the solitary exception of those where a wide angle of view is required. The latter is a facility which is not embodied in a reflex instrument, since the space which must necessarily be provided for the moving mirror does not allow of the use of a lens of short focus in relation to the plate. And last, the reflex is a camera which, like a high-grade automobile, is cheap to run, i. e. economical in operation. The proportion of spoiled material is cut down to a minimum by its accuracy in the ways already mentioned, and its construction renders impossible such minor wastage as results from making an exposure with the lens covered or stopped down, mistakes which most of us make at times with an ordinary hand-camera.

—and Drawbacks

On the other side of the balance-sheet are certain features which will rank as drawbacks largely according to one's circumstances. These are bulk, weight, cost, and conspicuousness. A reflex of box pattern and quarter-plate size (3¼ x 4¼) measures roughly 6 x 6 x 6 inches; a 4 x 5, about 7 x 6 x 7, and a 5 x 7, about 9 x 8 x 9 inches. The weights will run about 4, 5, and 8 pounds, respectively, and the cost $50 (£10) to $100 (£20) in the case of a medium-priced instrument. The more conspicuous action entailed by looking into the hood of a reflex is no drawback at all in perhaps 90 per cent of average work: it is a disadvantage chiefly when one is seeking to get figure studies unknown to the subjects, though here, as we shall see, there are ways and means of using the camera adroitly so as to conceal its purpose.

Depth

Before coming to the features which are desirable in an efficient reflex camera, let me say a word on the "depth of focus," more properly termed "depth of field," which lies at the back of all hand-camera work. Briefly, the larger the actual diaphragm or "stop" in a lens (regardless of focal length) the lower the capacity of the lens to render near and distant objects in focus at the same time. Hence a lens requires to be of quite short focus or, if of long focus, to be used with a comparatively small stop in order to get everything further than, say, 4 yards from the camera into sharp focus. For example, with the focus set on something 4 yards away, a 4-inch lens can be used at *f*/5.6 and everything up to extreme distance be obtained sharp, whilst an 8-inch lens under the same conditions will require stopping down to *f*/22. In other words, the bigger we make the diaphragm, either by using a high-speed lens or one of long focus, the lower the power to get near and distant parts of the subject sharp; which means that the combination of great depth and high speed of lens limits us to a lens of short focus, in actual practice to one of 3 or 4 inches. Now a reflex camera will not do anything whatever to increase the depth given by a lens of such and such an actual diameter of aperture. What it does do—and it is a most valuable property—is to show us exactly where the depth of field is operating. Thus it enables us to localize the field of definition in any desired part of the subject—which very often is all that the picture requires; or alternatively, causes us to see the necessity of using a smaller stop in order to secure a greater depth of definition or sharpness throughout the picture. In other words, the reflex makes certain the use of a very shallow field of "depth," as when using a large-aperture lens of 6 or more inches focus or when photographing a very close object such as a bit of carving on a large scale. Anyone who has done any same-size copying knows that the slightest departure from the correct distance betwen lens and object is fatal to the sharpness of the image in the negative. It will not do to trust to judgment of distance in such cases, but with a reflex the exact focus can be got almost as certainly as with a table copying camera. In short, the reflex camera replaces by an instinctive act of focusing, as judged by the picture on the ground-glass, the elaborate tables of depth with various lenses and apertures and for various distances from the camera which are drawn up for guidance in hand-camera work but are at the best a cumbrous help.

What Size of Camera?

Coming now to the choice of a reflex, the first thing, I think, is to settle in one's mind what size one shall adopt. Bulk even more than weight is the chief drawback to a reflex and it must be realized that the 4 x 5 size or anything larger adds a separate piece of baggage to one's holiday belongings or equipment. None of these larger cameras are things which can be put into a suitcase or kit-bag, when one is going away for a day or two, on the chance of subjects turning up, and even the 3¼ x 4¼ will often prove a nuisance if one's outfit is small. Moreover, any reflex larger even than 3¼ x 4¼ with a supply of plates or film becomes something of a load in the course of a day on foot. To classify the sizes roughly, I would say that the 2½ x 3½ (or 2¼ x 3¼) and 3¼ x 4¼ are the only two for the man or woman who intends to carry the camera as he or she would a folding Kodak. The 4 x 5 and 5 x 7 are for those—press photographers, automobilists and the like—who have to bear the burden of the apparatus only every now and then, whilst the postcard (3½ x 5½) reflex, if of a certain pattern, forms a compromise which, if its limitations are recognized, may be adopted by either of the two classes of reflex workers mentioned.

Which Small Size? Of the two sizes, 2½ x 3½ or 3¼ x 4¼, my own preference—and I have used both—is for the smaller, and I will tell you why. Both give pictures which are not of much use without enlargement except as mementos in albums, and for that the smaller size is pretty nearly as good as the larger. In enlargement, owing to the greater depth of focus, the 2 x 3 negative will give as good an account of itself, up to, say, 9 x 12 inches, as the 3 x 4. Moreover, the smaller negatives are just the right size for stereopticon slides by contact, whilst the larger are about an inch too large and compel one to go to the trouble of making diapositives by reduction in order to get the whole of the subjects which, with a reflex, it is so easy to place "just right" in the full space of the plate. These points perhaps would not decide my choice if they stood by themselves, but they are further strengthened by a saving in cost of plates or film of over 30 per cent, and finally the balance in favor of the smaller is toppled down by the lesser bulk of the camera. A quarter-plate box reflex, if of the revolving-back pattern, has got to be taken by itself if one is going for a trip, but the 2¼ x 3¼ or 2½ x 3½ is just compact enough usually to pack with other things in one's baggage without inconvenience.

Pattern The choice of size is, however, dependent to some extent on the build of the camera. Reflex cameras are some of them built oblong—that is to take a picture only "landscape way" of the plate—whilst others are made square, with a square focusing-screen in the top and a revolving back by which the plate-holders can be quickly turned into the upright or horizontal position whichever form the subject is desired to have. The square pattern is of course one which more completely fulfils practical requirements but it is necessarily more bulky than the other. For example, the 3¼ x 4¼ square revolving-back pattern of the Auto-Graflex measures 8¾ x 5½ x 7½ as compared with 5¾ x 5⅜ x 6¼ for the ordinary Graflex taking the same size of picture. Look at these figures again. While the majority of outdoor subjects take the horizontal form, the advantage of placing the plate vertical when a figure study or similar subject requires it, hardly needs to be pointed out. With the ordinary pattern an upright picture can be taken only by holding the camera on its side. It is then still possible, though not at all convenient, to see and focus the picture, by the aid, if it can be so called, of the sideway projecting hood. If the best treatment of all kinds of subjects is a consideration, the square pattern is fully worth its extra cost and larger size. The long narrow postcard size of picture is about the only one which does not call for a vertical position, and this size and pattern of reflex is therefore one which is very suitable for outdoor screens and similar subjects, whilst of comparatively slim dimensions.

The Mirror

The next point in regard to which reflexes differ is the mirror. In the better patterns, the mirror is actuated by a spring so that, the moment you press the shutter-release, the mirror automatically swings into the up position and is held there by the spring, the shutter immediately coming into operation. In other patterns the mirror is raised by pressure of the finger on a lever placed outside the camera. When it has thus been pressed up, the last bit of thrust on the lever releases the shutter and, on removing pressure from the lever, the mirror falls again. There are things to be said for both of these movements, but the better of the two is unquestionably the raising of the mirror by a spring for the following reasons: The operation of the camera in making an exposure is smoother; the mechanical work is done by the spring and is not subject to jerk or jar as it is liable to be when by hand. Also the spring-action is more regular than that of the hand in determining the interval between pressure on the release and the exposure of the plate. This interval depends only on the spring, whereas with the hand-raised mirror it depends on the vigor with which the lever is pressed down. Also the hand-raised self-falling mirror is free to move and flop about when the camera is pointed downward, requiring a separate locking device if it is to be used in this way and, last, the camera cannot be held upside down over the head for the purpose of photographing over obstacles, a method which, as we shall see, is sometimes of real practical value. Altogether the spring-raised pattern is the better and is that adopted by makers of the more expensive cameras. The advantages claimed for the self-falling mirror are more imaginary than real.

Shutter and Mirror

There is another point with reference to the mirror which must be mentioned. In some few cameras the shutter cannot be re-wound after an exposure whilst the mirror is still up. With such models you have to put the mirror down and so cover the unprotected film or plate before you can wind the shutter. Personally I like this arrangement, because it is an automatic preventive of accidental fogging of the sensitive film through careless re-setting of the shutter before the mirror has been put down. It is, however, a useless movement if the shutter is of the "self-capping" type, that is one which presents a slit when it runs down but forms an unbroken curtain when it is re-wound. Even if the shutter is not of this type, many reflex users prefer to forego the safety device, since by so doing they get the facility of using the shutter independently of the mirror. This is certainly an advantage, especially when one has to use the reflex on a tripod or some other support where it is very awkward to look down into the hood for focusing. In these circumstances, the picture can be viewed and focused on a second screen (supplied with most reflector cameras), which fits into the place of the plate-holder and is removed in order to insert the latter, just as in the use of the ordinary type of camera. If one can't do this, exposures have to be given by means of both mirror and shutter and often call for some delicate maneuvering. It is largely a matter of personal preference which is the better system of the two.

Focusing-Screen

If the camera is of the square revolving-back pattern, the focusing-screen is also square or nearly so, and requires to be marked so as to show plainly the space and proportions of both the upright and horizontal pictures. I have used for years with entire satisfaction a screen marked in the way adopted by Newman and Guardia (and possibly by other makers) for their cameras and consisting simply of an opaque square patch (black varnish) in each corner of the square screen. The side dimension of each corner patch is just half the difference between the long and short sides of the plate. For example on a quarter-plate screen, measuring, say, 4 x 4 inches, the corner squares are ½ x ½ inch. They very plainly indicate a 3 x 4 space on the screen upright or horizontal according as (in looking at the picture) one ignores the two side panels or the top and bottom panels which are formed by joining the inside corners of the squares by bold pencil lines. I would just as soon have this simple marking as the elaborate automatic masks which in some cameras are connected with the revolving back and move with it.

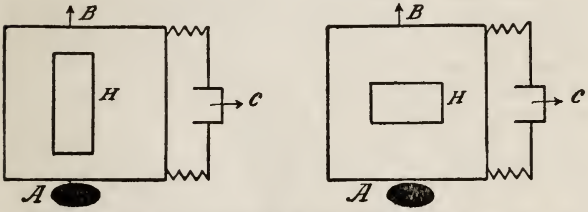
Usually the focusing-screen is fitted in the camera glass side up, in which position it will often make viewing and focusing difficult if the hood fits the head badly and lets stray light in on to the reflecting glass surface. Some workers find themselves bothered by the reflection of their eyes which they see in these conditions. They can remove the defect by having the screen placed ground side up, the rabbet in which it rests being lowered by the thickness of the glass. The only objection to this is that the ground side holds dust and dirt more than the polished surface and a dirty screen is inimical to easy focusing. And this brings me to a very vital practical feature of a reflex.

The Hood

Anybody with no experience of a reflex will appreciate the necessity of a hood which affords a clear and comfortable view of all but the extreme corners of the picture. The clear view is a matter of the shape of the hood when erected; the comfort largely depends on the height, which should be from 7 to 8 inches. But a necessary feature of the hood which perhaps will not be anticipated is that it should be quickly turned back so that the whole screen can be dusted or wiped. It is more important to be able to do this quickly than it is to get at the mirror readily. In the course of a day's work the screen will get dusty or may become spotted with rain drops. Either makes sharp focusing almost impossible, and therefore I put a hinged or otherwise semi-detachable hood as a very important feature. Very short-sighted people, who find a difficulty in focusing from the distance of the mouth of the hood, can have the latter fitted with a suitable pair of glasses. In Britain this fitment is supplied by the firm of Marion so that it folds flat against the inside of the hood, remains there when the hood is closed, but is instantly sprung into place for use when the hood is extended.

Reversible Hood

Another pattern of hood has been introduced of late years on European reflex cameras. It is one of the ordinary shape but attached to a loose square frame which can be clipped into position above the screen either way, that is with the oblong mouth of the hood either across the camera (the usual practice) or lengthways with it. The object of this second position is to enable the user to make a feint of photographing in a given direction when actually the lens is pointing in a direction at right angles. With a reversible hood it is easy to see and focus the real picture when one takes this side posture, but with a fixed hood it is very awkward to look with both eyes through the narrow dimension of the hood-mouth. The two plan-diagrams (Figs. 1 and 2) will make this clear. The reversible hood is quite a useful feature in figure-study work or whenever one wants to photograph without the subject's attention being prominently called to the fact, as at public meetings out-of-doors and street photography.



FIGS. 1 and 2. Illustrating use of reversible hood. When the photographer stands looking in direction *B*, but with lens pointing in direction *C*, it is difficult to focus with hood *H* in ordinary position (Fig. 1); but easy with hood reversed as in Fig. 2. See also Fig. 5.

Focusing-Pinion and Shutter-Release

A further matter of some importance in choosing a reflex is the position of the milled focusing-pinion head and the shutter-release, whether these should be on one side of the camera or on opposite sides. It may seem at first that the latter is the better plan, on the ground that one can focus a moving subject with one hand and keep the other in readiness to actuate the shutter. As a matter of fact it is almost a practical impossibility to work in that way. In actual practice you focus on some determined spot and then wait until your subject gets there. You will never get sharpness with regular certainty by trying to keep track of a moving subject with the focusing-pinion. Hence no useful purpose is served in having the two adjustments on opposite sides whilst there are positive advantages in having them on the same side: The camera can then be grasped more firmly by the one unoccupied hand. Also one side of the camera is usually free from projections when this arrangement is adopted and can be laid flat and firmly on one side. This is a facility which is often of service in taking a view from the top of a wall or fence. With the camera on its base you cannot get high enough to look down into the hood, but by laying it on one flat side you can look horizontally into the hood and have the release and focusing-head convenient to the hand on the upper side.

Other Movements

The foregoing end my list of movements peculiar to a reflex, but the latter, like any other high-grade hand-camera, is all the better for ample provision in the way of rising or swing front or extension. All the more so, since with a reflex the effect of these movements is seen on the screen as the adjustment is made, and is not merely guessed at as with most hand-cameras, in using which one has to trust to finders. An ample amount of rise of lens is one-third the height of the plate; one-quarter is pretty good but many reflexes permit only one-eighth and some none at all. Adjustment of the moving front by screw or rack and pinion is a great boon.

Few reflector cameras are fitted with a swing front for the lens, although this is a most valuable movement, particularly for high-speed workers who can employ it for securing depth of focus without sacrificing the full speed of a large-aperture lens. Apart from this, its absence will not be felt.

Extension

Inspection of the makers' catalogues will show that the maximum distance obtainable between lens and plates varies, in different cameras, from about 7 to 15 inches in the 3¼ x 4¼ size: other sizes in similar proportion. A good many cameras permit about 9 or 10 inches. The question arises: Is a fairly long extension, say 12 inches for a quarter-plate, a really important feature in an all-purpose camera, or can it be dispensed with and a less costly, lighter, and more compact instrument chosen? My reply is that modern improvements in lenses have largely removed the necessity for double-extension capacity in the reflex. The object of the long extension is twofold: To use a long-focus lens and to use, on occasion, a short-focus lens for copying small objects somewhere about same size, that is with a camera extension of twice the focus. The first of these purposes is fulfilled at normal single extensions by the newer fixed-focus large-aperture telephoto lenses such as the Dallmeyer "Adon" and the Ross "Telecentric" working at *f*/5.6, yielding the crisp definition of an anastigmat, and requiring a camera extension of half or less than half their real focal length. The copying, which usually will be a very small proportion of the average worker's exposures, can be done either with the usual lens provided with an extension tube or box, or with an extra short-focus lens of focus rather less than half the maximum camera extension. For example, a little 4-inch anastigmat of *f*/4.5 or *f*/5.6 aperture serves excellently for this copying work on a quarter-plate. At extension for a same-size copy it will work at *f*/9 or *f*/11 and will cover the plate quite as well as subjects like flowers, rock specimens, living insects, etc., require. Naturally, a 5- or 6-inch lens would be better since it allows of greater distance between the subject and the lens and therefore gives better drawing. In fact, especially for the photography of such subjects, one would get a reflex of the longest extension obtainable;

but in view of their infrequency there is no real inducement to choose a double-extension reflex camera when this and the long-focus work can be done with the more compact single-extension pattern.

Focal-Plane Shutters

We have briefly noted the focal-plane shutter as an opaque blind, with a slit in it, which moves close in front of the plate, or, as usually expressed, in or near the focal plane of the lens. Now we must learn a little more about it. The speed of the shutter is determined (1) by the width of the slit and (2) the speed at which the blind moves, which, of course, is determined by the tension of the actuating spring. Both of these adjustments have been used in providing a range of speeds, but of late years some makers have inclined toward avoiding continual changes in the tension of the spring on the reasonable ground that they alter the spring's pulling powers. Thus they have sought to work with the spring always at one tension, or to vary the tension as little as possible and to obtain the range of speeds by different widths of slit. Given a constant tension, the effect of width of slit on the time of exposure is a matter more or less amenable to calculation, whereas the effect of different tensions is not. Thus several modern focal-plane shutters are designed to yield speeds from say one-tenth to one-one-thousandth of a second by the conjunction of one spring-tension with an adjustable slit, whereas others employ a series of spring-tensions with a blind containing slits of different and fixed widths. The N. & G. shutter is of the first pattern; the Graflex is of the second type. The blind of the latter has five slits of widths such that the exposure with the widest is about thirty times that with the narrowest. Thus with the spring at a medium degree of tension the range of actual speeds runs from, say, one-twenty-fifth to one-six-hundred-eightieth and there is not much necessity to alter the tension frequently. The tension may be high or low but, as will be seen directly, it is always better to work at a high tension and with a wide slit than with a low tension and a narrow slit. Better, that is, as regards the maximum light-action on the plate: mechanically the reverse is the case, a high tension is more trying to the mechanism of the shutter and tends to variation in exposures.

Self-Capping Shutters

These, as already mentioned in dealing with the camera, are designed to form a complete covering for the plate when the blind makes its return journey on re-winding after exposure. They are necessarily more complex than the ordinary type and, as the shutter of a reflex is about the only part of the apparatus which is liable to get out of order, it is good policy to choose the simpler pattern. In a reflex with a spring-raised mirror, which makes a light-tight joint with its seating when in the down position, there is very little advantage in having a self-capping shutter.

Efficiency

Now I must come to a matter connected with the focal-plane shutter which some may perhaps be tempted to skip on sight of some formula or symbol suggestive of theory or mathematics, or some other thing which the good reader looks upon as pure folly. But I beg for a reading in order to show the reader, first, that the theory, like the curate's lie, is a very little one; and, second, that this question of efficiency has a great deal to do with the best use of a focal-plane shutter. The reason of this is that with lens-shutters you take the efficiency as the maker gives it to you and do the best you can with it, whereas with the focal-plane shutter you can make it greater or less according to the way you use the shutter.

What is "Efficiency?"

Efficiency is not the easiest thing to explain in a few words. Take one example: If, during an exposure of, say, one-one-hundredth of a second with any shutter you like, the plate receives the full action of the lens for the whole of the period, we should say that the efficiency of the shutter is 100 per cent. But a shutter of this perfect efficiency does not exist, although the focal plane in some circumstances comes "as near as no matter" to it. With all lens-shutters some time is taken by the opening of the leaves or sectors of the shutter before the full aperture of the lens is uncovered and again some time in covering it again. Suppose that these two stages are such that the light-action upon the plate is equivalent to only one-two-hundredth of a second with the full lens-aperture, the efficiency would be half or 50 per cent. If equivalent to one-one-hundred-fiftieth of a second, the efficiency would be two-thirds or 66 per cent. Understand that efficiency has nothing to do with the time during which the shutter remains open, that is to say, its sufficient speed to render moving objects without blur: efficiency, as here discussed, is the measure of the amount of effective light allowed to act on the plate during a given exposure, whether long or short.

Focal-Plane Efficiency

Now it has often been assumed that the focal-plane shutter, from its construction, must inevitably pass to the plate all the light which comes through the lens. On the face of it, when you think of a slit or opening moving in front of the plate, it seems impossible that it can be otherwise. But that view overlooks the optical rules which govern the production of the picture on the plate—rules from which there is no getting away. These rules would be without effect if the shutter worked really in the focal plane, that is in contact with the plate, but even with a film focal-plane camera, the curtain is an eighth of an inch in front of the sensitive surface: with plates you have to put the surface a little farther back, a distance of ⅜ to ½ inch according to the make of the camera. That is the root cause of the efficiency of the focal-plane shutter being much less than 100 per cent in certain conditions. Those conditions are the use of a very narrow aperture or slit in the curtain and of a large-aperture lens. Either reduces the efficiency but the greatest reduction is produced by the two in conjunction.

The Why of Efficiency

Look at the diagram on page 307. It represents actual and not uncommon conditions, viz., a 5-inch *f*/4 lens in conjunction with a shutter, the curtain of which moves in a plane half an inch in front of the plate. Calling the diameter of the diaphragm D, it will be understood that the image is made up of an infinite number of cones of rays, having D as their base and coming to a point on the sensitive surface. I have drawn two of

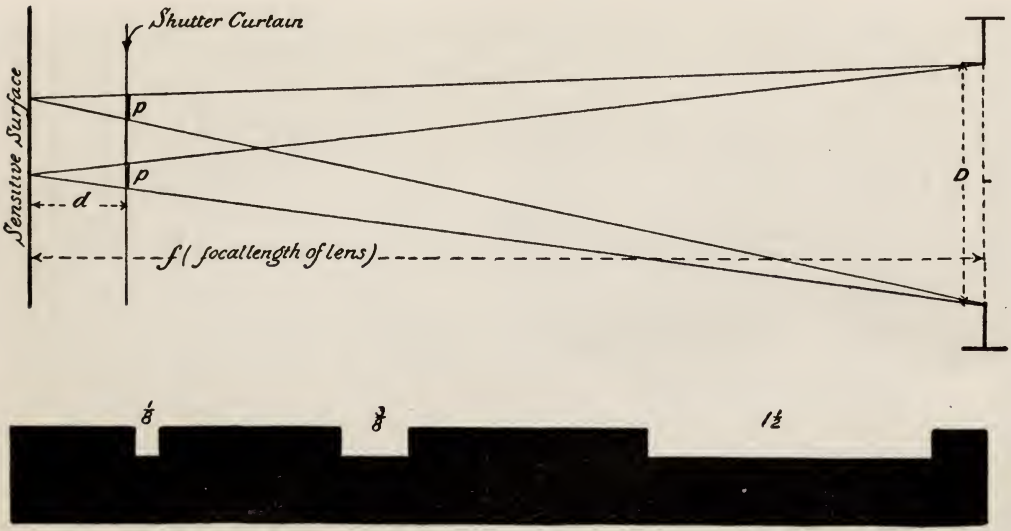


FIG. 3. The efficiency of a focal-plane shutter is conditioned by the width *P* of the pencil of rays from the lens diaphragm *D* in the plane of the curtain and by the width of the curtain aperture. A copy of the lower black strip can be made and used to show why this is so. See text page 306.

these, one exactly in the center of the field of the lens and the other a little away from it. You will notice that where these cones (as represented in section) meet the surface of the curtain, they are still of a certain, though small, width, in this case about one-eighth of an inch. Now try for yourself what is the effect of exposing the plates with a curtain-aperture of one-eighth inch width. With the diagram I have included a drawing to represent a blind with three apertures of ⅛, ⅜, and 1½ inches respectively. You can easily reproduce it with a piece of paper and a pair of scissors. Having done so, lay the notched edge of the paper on the line marked "shutter curtain" in the diagram and move it along that line until the narrowest notch just begins to uncover the short line *p* representing the width of the light-cone in the plane of the curtain. You will notice that you have to bring the notch, otherwise the curtain-aperture, right over *p* before *p* is fully uncovered and that the instant you move it further, the other edge of the notch begins to cut off *p*. In other words the full beam of rays is acting on this particular bit of film only for an infinitely short time: for almost all the time during which this particular bit of image is being formed on the plate only part of the beam is effective. And this is so for every other bit of the image and however fast or slow the curtain is moving.

Now try the two wider notches and you will see that they (the wider more than the narrower one) allow the beam of rays to exert its full action for a fairly long time in comparison with the time required for uncovering and covering it. In other words, the efficiency with the one-eighth-inch slit is low (actually only 50 per cent) whilst with the others it is much higher, viz., 75 per cent and 92 per cent.* This experiment, I hope,

*For the benefit of those who wish to know the basis of the above calculations, it may be pointed out that by simple geometry, the width *p* of the cone of rays is the curtain distance divided by the *f*/ number. This follows from the two triangles on the bases D and *p*. $D : p :: f : d$. Whence $p=\frac{Dd}{f}$. But the focal length (*f*) divided by the diameter of the stop (D) is the *f*/ number, so that $p=\frac{d}{F/No.}$

Further is it easy to establish a rule by which to calculate will make it clear that reduced efficiency results first from a narrow curtain-aperture and second from a comparatively broad cone of rays in the plane of the curtain, the breadth of this cone being greater the further the curtain is from the plate and the larger the working aperture of the lens.

Efficiency Figures

By the method given in the footnote on this page it is easy to calculate the efficiency of the focal-plane shutter for various widths of curtain-aperture and distances of curtain from plate and when a lens of large and medium aperture is used. A few such figures are worth setting down since they tell their own tale. Here they are:

I. EFFICIENCIES (in percentages). F/4.5 LENS

CURTAIN DISTANCE FROM PLATE	WIDTH OF CURTAIN APERTURE		
	⅛ inch Per cent	⅜ inch Per cent	1½ inches Per cent
⅛ inch	82	86	98
⅜ inch	60	82	95
½ inch	51	77	93

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the efficiency of the shutter under any conditions. Remember that the efficiency is the imaginary (calculated) time (T1) during which the cone of rays is fully operative divided by the time (T2) during which the cone is operative to any extent at all. Assume that the curtain is moving at a certain speed t, signifying the time, t, required for it to traverse an inch or a foot—it doesn't matter what the unit is for our purpose. To find T1, slide the notched strip representing a slit of width s along the line of the curtain and you will see that its passage over p falls into three sections, viz., one in which the length on which the full cone is operative, is $s-p$ and two others (at the beginning and end of its transit) in each of which the cone may be imagined as, first, completely covered and then just covered by a slit of width p. Each of these corresponds with the full action of a slit of $\frac{p}{2}$, so that adding these three sections together we have $(s-p+\frac{p}{2}+\frac{p}{2})\,t$ seconds as the time of the exposure during which the full cone is operative, in other words $s\,t$ seconds. Finding T2 is simpler. Again if you run the notched strip over p you will see that it is uncovered (wholly or partially) over a length $s+p$. Hence the time T2 is $(s+p)\,t$ seconds. And thus the efficiency or the ratio of T1 to T2 is $\frac{s}{s+p}$. This is a very simple formula and, although it may not be perfectly correct, since it assumes the blind to move at a quite uniform speed, it allows of figures for efficiency being usefully calculated.

II. EFFICIENCIES (in percentages). F/8 LENS

CURTAIN DISTANCE FROM PLATE	WIDTH OF CURTAIN-APERTURE		
	⅛ inch	⅜ inch	1½ inches
	Per cent	Per cent	Per cent
⅛ inch	90	96	99
⅜ inch	73	88	97
½ inch	67	86	96

The above figures apply to actual working conditions. In the roll-film Graflex the sensitive surface is ⅛ inch from the curtain: in the plate patterns, ⅜ inch. The curtain apertures here mentioned, ⅛, ⅜, and 1½ inches, are those of the Graflex.

Focal-Plane Maxims

The figures very clearly teach us several things, viz:

(1) With a curtain as close as ⅛ inch to the sensitive surface, it doesn't much matter how narrow an aperture or how rapid a lens you use: you will be certain of getting an efficiency at least over 80 per cent.

(2) With a fairly wide curtain-aperture—⅜ inch or over—it doesn't much matter what the curtain-distance or lens-aperture is: you will get efficiencies of from 99 per cent to about 80 per cent. Thus it is always better to get a given exposure by running a wider aperture faster than a narrower aperture slowly.

(3) It is when using the narrowest-aperture slit with a wider-aperture lens that the efficiency drops seriously. Under these conditions a small curtain-distance makes a great difference. These, of course, are the conditions for ultra-high-speed work, and it is here that the maker's skill in causing the shutter to approach the true focal plane is of chief importance.

Setting the Shutter

Before taking up the use of the focal-plane reflex in various branches of photographic work, I would just mention one point in regard to the shutter which may be overlooked by the intending purchaser of the camera. All makers dilate on the great range of speeds, but few of them say whether the speed can be altered whilst the shutter is set in readiness for an exposure; or, if it can, what kind of adjustment it is. But this is a distinctly important point in practice. Some shutters can have the speed altered only after they have been released. With them it is a nuisance to have to cap the lens or insert the shutter of the plate-holder in order to make a change. With others, an alteration in the width of the slit cannot be made but the speed can be reduced or increased by altering the spring-tension, that is supposing the spring is at a medium tension. With others the speed can be put to any figure, with the shutter set, by turning a key. With the Graflex, for instance, any slit or tension can be brought into operation whilst the shutter remains set, and in addition successive exposures with all the slits from ⅛ inch to 1½ inches can be given without further manipulation of the shutter. In other words you can give exposures in succession of one-three-hundred-fiftieth, one-one-hundred-tenth, one-fortieth, and one-tenth (or other series according to the spring tension), by simply putting down the mirror each time. I don't know that there is any great advantage in being able to do this—it simply follows from the excellent multiple curtain of the Graflex—but a facile alteration of the speed whilst one is waiting to make an exposure is sometimes necessary in order to deal with developments in a moving subject and is always a convenience in making the requisite change of speed from subject to subject.

Using the Reflex

One may roughly divide reflex work into two classes, namely the photography of ordinary views, figure studies, and other subjects without any very rapid movement in them and, second, the photographing of sports of various kinds, automobiles etc., in which the subject is in rapid motion and often comparatively close to the camera. Subjects of this latter class call for refinements in the use of the camera which are quite unnecessary in dealing with the more ordinary scenes and people such as are recorded by the least-expensive hand-camera but are handled with immensely greater certainty by a reflex. I will first deal with the more ordinary subjects.

Keeping the Reflex Fit

While there is nothing in a well-made reflex which requires constant attention, there are one or two points to be looked to before taking the camera out. See that the mirror is clean by dusting it with a very soft brush. A few specks of dust do not matter, but a layer of dust all over it will interfere with a bright and sharp picture on the focusing-screen. The latter also should be wiped clean with a handkerchief. If the camera has been kept for long in a cold place the shutter curtain may be a little stiff. Therefore see that it runs freely even at the longest exposures by letting it off a few times. If it doesn't, a few minutes in a moderately warm place will put it right for smooth action.

Holding the Camera

Like any other hand-camera, the reflex does not require to be clutcned with convulsive tightness in order to hold it steady. In fact that is just the way to insure a little shake or tremor at the moment of exposure. Simply hold it firmly but without clenching or stiffening the muscles. I prefer to support it against the body with one hand, leaving the other fingers free, first for focusing and then for operating the shutter. The beginner is apt to clasp the camera so tightly that vibration is set up from the tension of the muscles. Hold the camera almost slack and then you will have no occasion to charge a costly instrument with giving a blurred negative.

Lens-Stop and Shutter-Speed

For general work a lens-aperture of *f*/6 is the most useful. If the focal length is anything over 5 inches, the depth of field with *f*/4.5 is not enough for all parts of the subject. A lens of this larger aperture is useful chiefly for figure studies, animals in zoos, and similar subjects where one wants to focus almost entirely on one spot and prefers the rest not to be equally sharp. And for such work a focal length from twice to three times the long side of the plate is a good choice, so long as the lens front is big enough to take it, as it enables one to get further away from the subject.

With *f*/6 a shutter-speed of one-fiftieth to one-twenty-fifth of a second with an extra-rapid plate (not the very fastest ultra-rapid) will be about right for full exposure of average subjects. Under such conditions it is easy to use a smaller stop if the shutter-speed is judged too slow, or to speed up the shutter if the movement in the subject requires it. But the real one-fiftieth or one-hundredth second given by a good focal-plane shutter is ample for sharp rendering of moving objects like vehicles, people, animals which are not in rapid motion and, as is still more material, are being reproduced quite small in the picture. Thus the reader will see that for all such work a curtain aperture of at least ¾ inch can be used, a shutter-efficiency of about 90 per cent being thereby secured.

Shade the Lens

When using any lens, but most especially those of the more-complex construction employed to get an *f*/4.5 aperture, there is a great gain, as regards brilliancy of the negatives, in using the hinged shade provided on most box-pattern reflexes. But in adjusting the angle of the shade don't rely absolutely on the absence of a dark band across the upper part of the picture on the focusing-screen. Better to be content with a higher angle than risk obstructing the view by setting the shade too low. It is not easy to judge on the focusing-screen exactly when the shade has been lowered so as just not to obstruct the rays which form the picture, wherefore it is well to leave a margin.

Follow a System

The reflex being a camera with a number of movements, it is well to make it a rule, after each exposure, immediately to restore matters to some standard condition which each worker may adopt as normal. First put the mirror down, then re-set the shutter, and, if thought well, restore the lens to center, if it has been raised, and the revolving back to horizontal, if the less usual upright picture has been taken: also the lens-aperture to whatever F number be taken as standard. A little method applied in this way will obviate mistakes due to overlooking previous and forgotten adjustments of the apparatus.

Over Obstacles

One of the defects with which the reflex has been charged is that it is always necessary to hold it with the lens at about the waist-level, owing to the necessity of looking down the hood. It is only seldom that this is felt to be a drawback, but occasions do arise when one wishes to photograph at the eye-level or from a still more elevated standpoint. There are, however, ways of getting over the difficulty. Take, for example, the case where one wants to avoid including a fence or wall in the picture by placing the camera on the top of it. It is then generally impossible to view the picture in the hood with the camera in the ordinary position, but you can lay or hold it on its side, with the hood horizontal, and can then look into the hood from a sideway position as shown in Fig. 4. It is in such circumstances as these that the reversible hood and the placing of focusing-head and shutter-release on the same side of the camera are a real convenience.

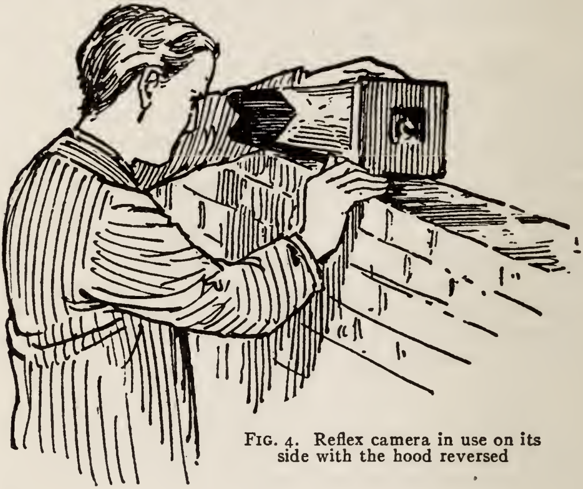


FIG. 4. Reflex camera in use on its side with the hood reversed

If the fence is still higher and takes a form which affords no support for the camera, a quite practicable method is to hold the camera at arm's length directly above the head and to view the picture by looking up into the hood. As both hands are required to hold the camera steady, focusing is by no means easy: the camera should have a stout carrying strap so that one hand can hold it aloft whilst focusing is being done. The most troublesome thing is to make certain that the camera is being held level but nevertheless this is a method which is of much service on occasion. It requires the mirror to be of the spring-raised type.

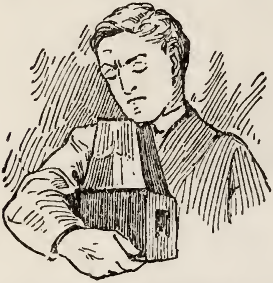
The photograph of Swanston, R. L. Stevenson's home in this issue, was made in this way. The little estate stands within a close hedge and only by this means could a photograph be obtained of it from outside.

Apart from photographing over an obstacle, this high upside-down position of the reflex is useful in dealing with scenes where it is required to spread out the foreground. Fountains, flower-beds, ornamental waters, are examples of subjects which are more effectively rendered in this way. A rapid exposure requires to be given in order to provide against unsteadiness of the apparatus while so held.

Figure Studies

For this class of subject, the chief thing is to keep the camera from attracting the attention of figures when it is desired to photograph them free from the awkwardness of a self-conscious pose. A long-focus lens is a great help as it allows of one stalking one's subject from a greater distance. But the more effective means of avoiding or disarming notice lies in abandoning the usual conspicuous plan of holding the camera. Instead, we can make a feint of photographing in a different direction. Think of the subject as placed in the space below the type on this page. Then if we take up a position facing, say, from right to left, across this page, the camera can be held with its side against one's body, so that the lens points directly toward the subject. With a sunk lens, as fitted to most box-pattern reflexes, the real purpose of the apparatus is not at all evident. One then sees sideways on the focusing-screen the subject which lies directly on one's left, although by action of one's head straight forward one conveys the impression that the subject lies there. This system is workable with a fixed hood although it is much more conveniently carried out if the hood can be reversed so that the long dimension of its mouth runs lengthways with the camera (as shown in Fig. 5, which illustrates this method). This position of the hood aids the deception, and it is also of advantage to have focusing-head and shutter-release on the same side of the camera.

Another plan, though not so effective, is to stand with one's back to the subject as shown in Fig. 6, pushing the reflex through the short tunnel made by one's arm and looking sideways at the ground-glass. Still another method is to focus and compose the subject by using the camera in the ordinary way and then, as if dissatisfied with it, to face round in the opposite direction or to stroll away, at the same time closing the hood. Then if it is seen that the figures have returned to a natural pose one can turn about swiftly and return to the previous spot, bring the camera to the front, quickly sight the subject, and make the exposure.



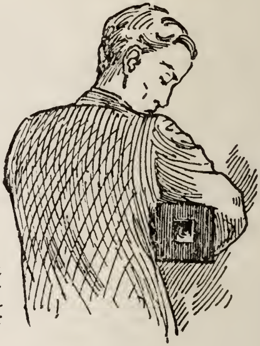


FIG. 5 (left). Pointing reflex to left while taking a position in forward direction. Hood reversed. FIG. 6 (right). Photographing with reflex held under arm.

A Lens-Mirror

Another and most effective plan for thus drawing attention away from the photographer's actual operations consists in the use of a second mirror placed in front of the lens at an angle of 45° to the lens axis. With it one photographs to one side or the other while the lens and the operator are looking straight in front. The worst of this method is its cost. The silver-surfaced glass requires to be optically flat, is liable to be damaged, and, owing to its exposed position, may frequently require re-silvering. On the other hand a permanent metal mirror such as Kahlbaum's is very heavy and costs not much less than the reflex to be fitted with it. The only practicable plan is to mount a glass mirror in a tube or box provided with a door which can be kept closed when the attachment is not in use. The accessory is made to screw on to the camera lens and can be constructed to look like a larger objective. In fact the more conspicuous the whole fitting is, the better for disarming suspicion. By means of it, exposures at quite close quarters may be made entirely unknown to the subjects and the accessory has proved of value in obtaining records in countries where the camera is feared or tabooed on religious grounds.

Copying Work

I have already referred to the usefulness of the reflector type of hand-camera in photographing quite small things on a fairly large scale with the camera held in the hand. In that respect its chief merit is time-saving. If you are using a hand-camera such as an F. P. K. in which focusing is done by means of a scale, the only really satisfactory plan of dealing with objects a few feet away, say 2 to 6 feet, is to measure out the distance and then to set the focusing-scale accordingly. That is a rather slow job and with a wide-aperture lens is not free from uncertainty. With a reflex it is just as certain and rapid an operation as photographing a distant landscape. If your camera is of the double-extension pattern the ordinary lens is as good as any other, for if it can be placed twice its focal length from the plate an object can be copied same size, although such a large scale will rarely be wanted. If of single extension, it may still extend far enough for all but the most exceptional subjects: or a short-focus lens, specially for use in such cases, can be provided. In any case, remember that whenever extended appreciably beyond the distance for focus on distant objects the working aperture (F number) of the lens is no longer that marked on the mount but is the extension divided by the actual diameter of the stop in use. It is a simple matter to find out what these stop values are for, say, every inch of extra extension. In doing this it is necessary to get the figures only for the largest stop of the lens. If it *is* necessary to use a smaller—it usually isn't—you need only give twice or four times the exposure in the usual way. For example if the real *f*/ number (full *f*/6 aperture) is *f*/10 and you have to use the stop marked *f*/8, you need to give double that required for *f*/10 or four times if the lens is stopped down to *f*/11.

Orthochromatic Exposures

One point in favor of a reflex which I have not touched upon is the facility of making exposures with a light-filter. The large aperture of lens which can be used coupled with the high efficiency of the shutter at a slow speed makes it quite practicable to give exposures of one-tenth or one-twentieth of a second through a five-times ray-screen on average subjects. A tenth of a second is about the slowest exposure which a focal-plane shutter will give and this is the speed which should be used for orthochromatic work. If a less degree of exposure is sufficient, it is secured by the use of a smaller stop.

High-Speed Work

In the photographing of subjects in the most rapid movement we come up against difficulties each distinct in itself but all connected together. The chief thing is that the negative should be free from blur due to movement of the subject, i. e., that the motion should be "arrested." Whatever else the photograph may be it is self-condemned if it is not that. A moment's thought will make it clear that the shutter-speed which is necessary depends not directly on the movement of the object but on the movement of the image on the plate. The shutter aperture must move over a given space of the plate at least a little faster than the image moves on that part. The movement of the image depends on several things which we will consider in a moment. Also with many subjects it is necessary to secure depth of focus. If that is done by stopping down the lens, the difficulty of striking a balance between an exposure short enough to stop any movement in the subject, but long enough to give a developable image on the plate is made more difficult, whilst a further factor which requires to be taken into consideration at times is the avoidance of distortion due to the fact that the focal-plane shutter exposes the plate not all at once but in successive bands or sections as it were, each the width of the curtain-aperture.

Subject versus Plate

In all high-speed work it is the subject and its sharp rendering which comes first. Ideas of correct exposure of the plate on the lines customary in ordinary photography must be given second place. Up to a speed of about one-three-hundredth of a second it is fairly possible to make negatives which are fully and correctly exposed in the sense that those made by time in a view-camera are fully and correctly exposed. But at higher speeds than that one-three hundredth to one-one-thousandth—it is largely a matter of making the most of the light-action which the plate has received. Don't take this as representing work in this region of higher speed to consist of feats of skill or chance successes. A very large proportion of ordinary hand-camera negative-making is marked by exposure which comes very far short of what is correct or full but is acceptable all the same. What I am seeking to enforce is that an exposure of one-five-hundredth or one-one-thousandth of a second may be given under conditions when in strict accordance with exposure tables one-one-hundredth or one-two-hundredth ought to be given and the result will not be altogether disappointing. The character of the plate and its method of development play their part, in addition to the fact that in high-speed work it is the form or drawing of the subject which is the chief consideration. The correctness of the scale of tones, for which correct exposure is a most essential condition, is of secondary importance. In the early days of the focal-plane shutter dry-plates were a good deal less sensitive than the ultra-rapid emulsions now obtainable, and it was not possible then to think chiefly of arresting motion and to let the exposure of the plate take care of itself. While modern improvements in plates have not been altogether such as to allow us to take their speed as sufficient for all high-speed work in reasonably good conditions, they are so much nearer to that ideal that in a very great deal of work we can make the speed of the moving subject the basis for the setting of the shutter and need not fear that the plate will thereby receive a hopelessly insufficient exposure.

The Moving Image

Apart from the actual speed of the object, the speed of movement of the image on the plate depends on two things: (1) The direction of the moving object in relation to the axis of the lens and (2) the relative size of the image or, in other words, the scale of reproduction. The image is larger and therefore moves faster the nearer it is to the camera or the longer the focus of the lens. As regards securing sharp definition of a moving object, it doesn't matter whether an image of a certain size is secured by a near standpoint or by the use of a lens of longer focus further away. The latter plan, as we shall see, has advantages over the former.

Direction of Movement

First think of factor No. 1. If the object is moving straight toward the camera—let us suppose exactly along the lens axis—the image as a whole does not move on the plate. It only gets larger. On the other hand if the object moves directly across the field of view, that is at right angles to the lens-axis, the movement of the image is at its maximum. In practical work this is one of the first things to recognize. Comparatively few sporting subjects can be taken "dead on:" it is out of the question to plant oneself right in the path of runners or a horse-race, apart from the unsatisfactory nature of the photographs so obtained. On the other hand if the subject is passing straight across the field of view, the result is equally unpleasing pictorially whilst the exposure requires to be something very much shorter in order to avoid blur due to movement of the image. Therefore on both counts, the best plan is to take a position so that the lens points in a direction about "half and between" these two extremes, as illustrated in Fig. 7. In other words not as at A or B but as C or D so that the direction of the moving object makes an angle C (45°) or D (30°) with the lens-axis. In these circumstances the shutter requires to be worked at a speed about two-thirds that necessary in position

A, though about twice that required in position B. In taking up this mid-angle position everything depends on the distance one wishes to be from the object at the chosen instant of exposure which brings us to the next point, i. e. relative size of image.

Size of Image

The basis of all calculation here is that the proportion of the image on the screen to the actual movement of the object is exactly the same proportion as the size of the image to the size of the object. The object may be traveling at a high speed, but if the image is minute on the screen through the great distance of the object or the short focal length of the lens the movement of the object will be minute and *vice versa*. How then are we to make allowance for different distances and focal lengths of lens in fixing on a standard for working? Very simply, by leaving these things out of account and fixing on an image of a certain size. As a rule the subject will be a man or a horse, the height of either of which may be taken as 6 feet. A convenient size for the image is 1½ inches which is a degree of reduction of one-fiftieth.

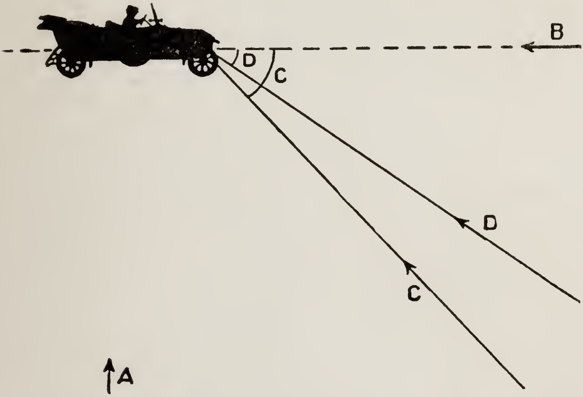


FIG. 7. Positions *A*, *B*, *C* or *D* of camera for photographing object moving in direction of dotted lines. *A* represents maximum movement of image on plate. *C* or *D* is a favorable position for average work.

Distance from Object

Now perhaps we begin to see some order emerging from the chaos of these questions. If we remember our optical rules, or, alternatively, if we can refer to The Photo-Miniature No. 140, we shall know that for an image one-fiftieth the size of the object, the distance from one to the other, or nearly enough for practical purposes, is fifty times the focal length of the lens. That is to say for a 1½-inch image of a 6-foot man or horse the distances of the camera with lenses of various focal length are as follow:

Lens—focal length Inches	Distance Feet	Lens—focal length Inches	Distance Feet
5	21	12	50
6	25	14	59
7	29	16	68
8	33	18	76
10	43	20	84

These are rough indications to go by but it is not necessary to remember or judge them when using a reflex: a couple of pencil marks 1½ inches apart on the focusing-screen will serve for adjusting matters. Though the subject proper will not be available beforehand for this purpose, it is almost always possible to find a man standing where it is intended the subject should be and to take such a position for the camera that his image just about fills the space between the two marks.

A Working System

So here we have roughed out a system, viz., a 1½-inch image of the human or equine subject on the focusing-screen, and at the same time a standpoint for the camera such that the subject presents itself about half sideways-on (C or D, Fig. 7), or rather will do so when it gets to the point at which the exposure is to be made. More often than not, one knows what its course will be and can judge this latter. At the same time let it be understood that this is not a hard-and-fast rule but on the contrary one to be departed from as circumstances suggest. It does, however, provide a basis by which to judge variations which are needed or advisable. If the image is larger we know the exposure most be shorter: if it is

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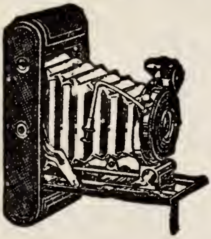

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Subjects and Shutter Speeds

Under the conditions defined in the previous paragraph fair indications of shutter-speed are as follows:

Horses, galloping or jumping	1/900	Diving	1/600
Horses, trotting	1/800	Golf and Tennis	1/1000
Cycle- (not motor) racing	1/500	High jump	1/800
Foot-racing	1/500	Vehicles (10 miles per hour)	1/200
Fast skating	1/700	Pedestrians	1/80

If the subjects are moving across the field of view these exposures require to be about one-third faster, that is to say the lower figure in the number for the fraction of a second requires to be about half as much again—one-nine-hundredth instead of one-six-hundredth. If, however, the subjects are coming end-on to the camera, exposures can be about twice as long. As regards the size of image, one-half the size will allow twice the exposure whilst one double the size would need doubling the speed of the shutter. But the latter is not a practicable program for the fast subjects, on account not only of the incapacity of shutters but also of the inadequate exposure of the plate. The useful limit as regards size is marked, for fast subjects, by the 1½ inches and it is better to depart from it in the other direction of a smaller image and a greater degree of enlargement of the negative.

Limb Movement

In drafting the foregoing suggested exposures, the basis, derived from both experience and calculation, has been that of the rate of movement of the object as a whole. But it must not be forgotten that apart from this motion, say of a runner or a cycle, there is a still more rapid movement of the legs or the spokes of the wheels. To get this part-movement of the subject sharp on the plate the exposure must be considerably shorter, say, one-eight-hundredth or one-one-thousandth where one-five-hundredth would be quite enough for the general forward movement. Other subjects like diving, skating or the long jump do not come within this category:

the movement of arms or legs is not an extra to that of the body. In the case of galloping or fast-trotting horses or high-speed automobiles, one is usually working at the highest speed of the shutter and the only way to get greater sharpness of moving legs or wheels is to have a smaller image.

Focusing- and Movement-Blur

One thing which also requires to be kept in mind is that any shortcoming of the shutter in the way of insufficient speed is aggravated if the subject is not in really sharp focus. Of course the two things are quite distinct and it is easy to tell from the negative, especially with the aid of a magnifier, which is the cause of unsharpness. But if the cause *is* movement of the image during exposure, it is clear that such blur will be greater if the moving image is itself bigger than it should be through faulty focusing. This is liable to creep in particularly in dealing with sharply defined objects such as swords and lances in military sports, the club of the golfer, or the racquet of the lacrosse player.

The Swing Lens

I referred in the beginning to the use of a swing front to a reflex in high-speed work. The movement is very useful because it often enables one to get depth of focus without reducing the aperture of the lens. The most useful form of the movement is that of Adams and embodied in the "Videx" reflex by which the lens can be swung up or down or to the right or left (that is around a horizontal or vertical axis) according to the way the lens-panel is placed on the camera front. Most other cameras have only the up-and-down swing if they have any at all, whereas the sideway swing is the most generally useful. The up-and-down swing helps to bring the foreground and distance (or mid distance) into focus without stopping down, whilst the sideway swing does the same for parts of the subject extended horizontally across the field and receding from left to right or *vice versa*. This latter is of more common occurrence, for example a group of runners approaching the camera, say, from right to left in a diagonal direction. In this case the lens has only to be swung more or less toward the left and the subject focused on the screen with it so swung in order to get the foremost man into focus at the same time as those behind. In the opposite case—figures approaching from left to right with the camera pointed at an angle of 45° or 30° to the line of travel (the C or D position of Fig. 7)—the rule is to use the lens swung toward the right. Try out this rule on standing figures and you will be able to judge of the amount of swing which is necessary. Care must be exercised in the use of this movement. If you swing the lens in the wrong direction you can make matters so much worse. The principle to bear in mind is that the lens should be swung so that it points further away from the more distant part of the subject. By so doing the rays of light forming the image of this part are skewed round, so to speak, and the surface in which sharp focus of near and distant is obtained, instead of being at an angle to the plate, comes more nearly into alignment with it—an aid to better definition.

Distortion

A lot has been said in the way of condemning the focal-plane shutter on the ground that the image of a moving object is formed piecemeal on the plate and not all at once as with a lens-shutter. For that reason, so we are told, the results with the focal-plane shutter must suffer from distortion due to movement of the image during the whole period of exposure. In theory that cannot be denied; in practice, as represented by perhaps nine-tenths of one's work, it is negligible, and in the case of the remaining tenth any distortion effect can be avoided by appropriate use of the shutter.

How Distortion Comes

Suppose you are photographing a runner moving *across* the field of view and are using the shutter so that the curtain runs from top to bottom of the plate. The image being inverted on the plate, and the direction of movement of the image of the figure being opposite to that of the figure itself, it follows that as the curtain-aperture comes down over the plate the feet or legs are exposed first and the head last. Hence the upper parts of the body have had a minute fraction of a second in which to move forward and therefore the figure may be rendered as leaning forward rather more than it actually is. That is one way in which distortion can conceivably occur, the effect taking the form of an angling of an upright subject one way or the other according as the curtain-aperture uncovers feet or head first. Another way in which distortion may creep in is when the curtain-aperture (on exposure) follows the image of the moving subject. The effect in that case would be to lengthen or draw out the image of the subject.

Precautions

Let it be understood that so far as average high-speed work—sports subjects and the like—this distortion effect can be put among the "would be's" and "perhaps's"—a pure bogey. It certainly is often marked in subjects moving at an excessively high speed, such as racing automobiles, but apart from focal-plane photographs themselves the best answer to critics of the shutter is the fact that some years ago a German professor found it necessary to take as his subject a 20-inch disk rotating at the rate of 400 revolutions per minute and placed only 4 feet from the camera in order to demonstrate the distortive effects of the moving slit. However it is of service to state the conditions in which distortion is least liable to occur. This is when the moving image of the object is met by the moving curtain-aperture, i. e. when they pass each other like two trains on a double track. Since the image moves in a direction opposite to that of the object, the rule is to hold the camera so that the travel of the curtain-aperture corresponds with that of the object. In most reflex cameras the curtain runs from top to bottom which is the best position for divers and falling objects. For objects moving right to left or *vice versa*, the best position is with the camera held on one side or the other which means that one must discard the viewing of the image on the screen, must focus beforehand on a given spot, sight along the closed camera and make the exposure when the moving subject has reached the appointed place. This is not an impossible method but actually the regular practice of press photographers. It will serve to avoid the slanting automobiles which one so often sees in the newspapers but it is an unnecessary refinement for subjects of less extreme speed.

Long-Focus Lenses

In high-speed work a long-focus lens offers several distinct advantages. Very often at public sports it allows one, from an ordinary seat in the spectators' stand, to do as well as the privileged press photographers in the enclosure. In photographing sports like throwing the hammer or putting the weight it removes one from positive danger. Moreover there is scarcely a single subject the "drawing" of perspective of which is not vastly better when taken with a 15- or 20-inch lens as compared with the average 6 or 8 inches. In fact, subjects like football or baseball, in which the players may move about anywhere over a wide field, can hardly be tackled at all except with a long focus. In Britain, the press photographers of phases in a big football match are almost always taken with a reflex of 4 x 5 or 5 x 7 size fitted with a large-aperture lens of 20 or 30 inches focus and mounted high up on a massive tripod, placed right off the field. In such circumstances, when one is working to get a figure of a given size, the long-focus lens is really at a light advantage as regards depth of focus.

—and Camera Extension

Fortunately it is not necessary to use reflex cameras at the long extension necessary for a long-focus lens of the ordinary kind; within the last few years opticians have introduced a type of lens—a fixed-focus telephoto—which is just the thing for high-speed work. Unlike other telephotos, the aperture is large, *f*/4.5 to *f*/6.8, whilst the camera extension required is just about one-half the focal length. The two lenses of this class which have been most used are the "Telecentric" of Ross and the "Large Adon" of Dallmeyer. The "Telecentrics" range from 9 to 17 inches focus (camera extensions, 5½ to 11½ inches); the "Adons" from 12 to 20 inches focus (camera extensions, 6 to 8 inches). Either is a power in the hands of the high-speed photographer in the ways stated in the previous paragraph and without the need of anything exceptional in the extension of the camera.

The Development of Extra Rapid Plates

BY T. THORNE BAKER

Despite the fact that the plate or film of ordinary rapidity is fully equal to the requirements of almost all classes of subjects under reasonably favorable light conditions, the hand camerist, as a rule, insists upon using the most rapid plate the market affords. Consequently, today, the ultra-rapid plate occupies a position of paramount importance, and is all too frequently employed where a much slower plate would do the work better, i. e., give a more satisfactory negative. So, on the one hand, the manufacturer is forced to devote attention and research to the production of high-speed emulsions, and, on the other hand, the photographer finds himself obliged to study the character and use of high-speed plates in order to get successful results with them.

Two Extremes

Let us first take the two extremes: a very slow plate and a very rapid one, and see wherein they differ. In this way we will reach an intelligent appreciation of the reasons for the methods of development herein described and, incidentally, get a better understanding of the comparative of slow and rapid plates.

The characteristics of a slow plate are chiefly : fineness of grain, freedom from the tendency to fog in development, and a readiness to give considerable opacity, so that unless carefully controlled in development, the negative is apt to be harsh in contrast or, as we say, steep in its gradation. On the other hand, the ultra-rapid plate is coarse in grain, and so does not give good "blacks" in the negative, the opacities being less compactly knit together, as it were ; with forced or prolonged development it is liable to fog, being more sensitive in its make-up to the action of the developing solution and to the light used in development; finally the negative is apt to be flat or soft in character, lacking brilliancy and snap.

The Aim

Clearly our aim in developing ultra-rapid plates must be to get a sufficiently vigorous negative with as little fog as possible, i. e., to get the image out in density and detail before the period of fogging is reached. This means a developer which will give the plate with its brief exposure every possible advantage. In making up such a developer it is necessary to omit all kinds of restrainers as far as possible, and yet to prevent the developer from acting upon the *unexposed* silver bromide in the film—which would produce fog. To accomplish this simultaneously with the attainment of density requires careful consideration, and obviously development must proceed along lines somewhat different from those usually followed.

Necessity of Safe Light

As plates of very high speed almost invariably possess some red-sensitiveness, they should always be handled with the same precautions usually employed in handling orthochromatic plates. Much of the failure and lack of success experienced with ultra-rapid plates results from ignorance or neglect of this important detail. The dark-room light used in filling the holders and in development should be a good ruby or green. Two thicknesses of double flashed chromium green afford a safe light for the most rapid plate, but, no matter what light is used, the reader will be wise in testing it. A simple and practical test is as follows: Hold the plate to be tested about twelve inches away from the developing light, and facing it, for two minutes. Now, in absolute darkness, take an unexposed plate out of the same box, and develop the two side by side for, say, five minutes in a pyro-soda or metol-hydro developer. After development rinse well and fix the two plates. If on examination in daylight, after fixing, the plate exposed to the dark-room light shows more veil or fog than the other, the dark-room light is unsafe and needs adjustment. Even with a safe light, it is wise to cover the tray during the first stages of development with ultra-rapid plates and to work in full light only at the finish, avoiding all unnecessary examination of the negative during its development.

These difficulties can be wholly avoided by filling the holders in absolute darkness and adopting a system of time or tank development which can be operated with a minimum of light. As the experienced worker knows, this is by no means as difficult as it is imagined to be.

Harmonizing Developer and Plates

A great deal depends upon the choice of a developer and its adaptability to the particular plate employed. As most workers with high-speed plates are aware, one developer will give crisp images and another produce persistent fog and weak images with the same plate. This can be ascertained only by experiment, and once the most favorable combination is found, it will be obviously wise to stick to it.

Pyro Soda

The first developer we will consider is pyro, as it is peculiarly adapted to plates of high speed and allows the maximum amount of control in development.

It has already been intimated that no portion of the work done by light action during the brief exposure must be lost, and as in focal plane work, indoor portraiture in a dull light and flashlight photography, the light impression is extremely feeble, we must not sacrifice shadow detail by the use of bromide in the developer. The following developer, therefore, contains no bromide, and its clear working quality depends on the bi-product formed by its two constituents, citric acid and sodium sulphite. Make up two stock solutions as follows:

The Formula

A.—Pyrogallol, ⅓ ounce; citric acid, ¼ ounce; sodium sulphite (cryst.), 1¼ ounces; water to make 10 ounces.

B.—Sodium carbonate, 2½ ounces; water to make 10 ounces. This developer, like those to be described later, should be used at a temperature of between 55° and 65° Fahr., preferably at the mean, viz., 60°. The influence of the temperature of the developer on the clearness of the negative is so important that emphasis must be laid on this point. With under-exposure such as necessarily occurs under trying or abnormal conditions, development must frequently be prolonged, and a cool developer is the readiest means to prevent "forcing" or long-continued immersion from discoloring the "whites" of the plate. It must be understood that faint detail is often buried and lost if fog appears, so that a clean negative is essential.

How to Use It

If we are reasonably sure of a correct exposure, development with the above formula may begin with equal parts of A and B. If there is any doubt about the correctness of the exposure, it is altogether safer to prepare two mixtures: one containing 3 parts of **A** and 1 part of **B**; the other consisting of one part of **A** and 3 parts of **B**. Begin development with the first mixture and add as much of the second mixture as may be required when the progress of development is seen.

There being no bromide in this developer, no fear need be entertained that by starting with 3 parts of **A** to 1 part of **B** the latent image will be destroyed; sodium citrate, the retarding constituent of the developer, is a *retarder* in actuality and cannot oxidize the exposed silver bromide. If, then, we begin development as though the plate were correctly exposed, i. e., using more of **A** than of **B**, we can get some idea of the character of the exposure. If the image flashes up, showing that the plate was grossly over-exposed, I can suggest no better remedy than the addition of 10 per cent potassium bromide solution and the continuation of development until all the details of the image are out. Now fix the plate and, subsequently, intensify to get increased density if this is needed. If, on the other hand, the image appears very slowly and the plate is obviously under-exposed, we can by pouring the second mixture into the dish render the developer normal, and add still more of **B** if it seems to be required.

With many brands of extra rapid plates difficulty is experienced in getting sufficient density in the high lights of the negative, and thus the use of rather more of **A** than of **B** is desirable in order to produce a vigorous image. If the plate was correctly exposed and the image begins to appear within 45 seconds, development may safely proceed with equal parts of **A** and **B**, or with 4 parts of **A** to 3 parts of **B**, according to the kind of negative desired, or the amount of vigor required in the contrasts of the negative by the printing-paper to be used later.

Metol

We will now leave pyro for a moment and consider metol, which I consider unequaled for the development of ultra-rapid plates with very brief exposures, provided that the plates are free from fog tendencies—in which plates differ. A metol developer without bromide will give us perhaps the largest advantage obtainable for any exposure, and the following formula is one I have used successfully for years: Metol, 73 grains; sodium sulphite (cryst.), 1 ounce; sodium carbonate, 364 grains; water, 10 ounces. Dissolve the metol in a portion of the water before adding the sulphite.

How to Use It

This developer is so energetic in its action that it is very desirable to test its suitability to your own particular plate before actual use. This is readily done, as already suggested for testing the dark-room light, by finding how much fog, if any, it produces on an unexposed plate immersed in it (in total darkness) for five minutes. For the same reason the solution should always be kept below 60° Fahr., during development, as a warm metol developer is apt to produce fog with very rapid plates.

In my own practice I place the plate in a tray, pour the developer on, cover the tray and leave the plate immersed for two minutes. The cover is then removed and the plate examined by transmitted light. According to its appearance on being looked through, it is then put back into the developer for another minute, or into the fixing-bath. Four minutes is the extreme limit of time for development with this developer, as in that period all that the exposure has effected will be revealed. Development, however, should always be carried on for at least half a minute after all the detail has appeared, or good blacks will not be obtained. Finally, where sufficient exposure has been given, the addition of 10 per cent potassium bromide solution (1 drop to each ounce of developer used) will help to keep the shadows of the plate perfectly clear and free from fog.

This metol developer, I may mention in passing, is excellent for three-color work or for orthochromatic copying, where it is often difficult to give a sufficiently long exposure, for I am of the opinion that it will "bring up" an image where the plate has received no more than half the normal exposure a plate would require with ordinary pyro-soda or hydroquinone.

Eikonogen

Eikonogen is also a developing agent with peculiar advantages for focal-plane work and extremely brief exposures on rapid plates. When used in concentrated solutions it is very energetic in action. It gives negatives of a grayish black color, not so good as "printers" as those developed with pyro. Two stock solutions should be prepared as follows:

A—Eikonogen, 200 grains; sodium sulphite (cryst.), 2 ounces; water, 10 ounces.

B—Potassium carbonate, 700 grains; water, 10 ounces.

Equal parts of **A** and **B** are used. Should the plates show any tendency to fogging, 2 grains of potassium bromide can be added to Solution **A**.

A single-solution eikonogen developer for use with rapid plates may be prepared as follows: Dissolve in 6 ounces of warm water, 100 grains of eikonogen, 1 ounce sodium sulphite (cryst.), and 200 grains potassium carbonate, with plates that have received a normal exposure. This solution may be diluted with an equal volume of water before use.

Tank Development

Owing to the enormous control which it allows, stand or tank development is peculiarly favored by many who use extra rapid plates for high-speed work. The principal feature of tank development is the employment of very dilute developing solutions, so that density is attained gradually and the shadow details of the negative have an opportunity to "come up" well before the high-lights are over-dense. Thus this method is said to give more harmonious negatives than the tray method, i. e., the contrasts are less harsh and a softer gradation is secured, so that it is peculiarly suited for the development of focal-plane exposures.

Glycin Almost any clear working developer may be used as a tank developer, the duration of development depending on the degree of dilution of the developer, which is controlled by the convenience of the individual. As glycin is well suited to work in diluted solutions, I give the following formula, which I have proved to be thoroughly reliable: Water, 100 ounces; glycin, 75 grains; sodium carbonate, 1½ ounces; sodium sulphite (cryst.), 75 grains. This developer can, of course, be used repeatedly.

Manipulation In this method the developing solution being prepared, a batch of exposed plates are put into the grooves of the stand developing boxes sold by most dealers (or a new, unused, grooved fixing-box can be used), and the developer is slowly poured in until the plates are quite covered. In this way air bells, streaks and bubbles are easily avoided, whereas if the developing box is first filled and the plates immersed afterwards, there is a continual risk of air bells, etc. Obviously this filling of the tank is done in a subdued and safe dark-room light. Development may take any time from 20 minutes to an hour or more, according to the dilution of the developer. An ordinary metol-hydro developer diluted with ten times its volume of water does not necessarily take ten times as long to develop as when the strong solution is used. But this detail can be adjusted by the reader to suit his own convenience by means of a few trials. In the use of the formula given above, remove a plate from the trough at the end of fifteen minutes, and examine by transmitted light. It will be seen at once how far development has proceeded, and the plate can either be put back into the tank or removed to the fixing-bath if sufficiently intense. Necessarily the duration of development for each negative in the batch will be determined by the amount of exposure it has received, apart from the dilution of the developer.

Review Briefly reviewing what we have learned, we may group our facts as follows: Learn to fill ultra-rapid plates into the plate-holders in absolute darkness, and to use as little light as possible during development; make sure that the light used is perfectly safe and will not fog the plates even during prolonged development; use a clear-working developer with as few restraining elements as possible, vigorous in its action, but free from fogging tendencies; keep the solution under 65° Fahr. in temperature to avoid all danger of fog; do not attempt to greatly force or unduly restrain a plate which has been abnormally under- or over-exposed, but develop normally as far as possible, fix thoroughly and then, by after-treatment, i. e., intensification or reduction, build up or reduce the image as it may need.

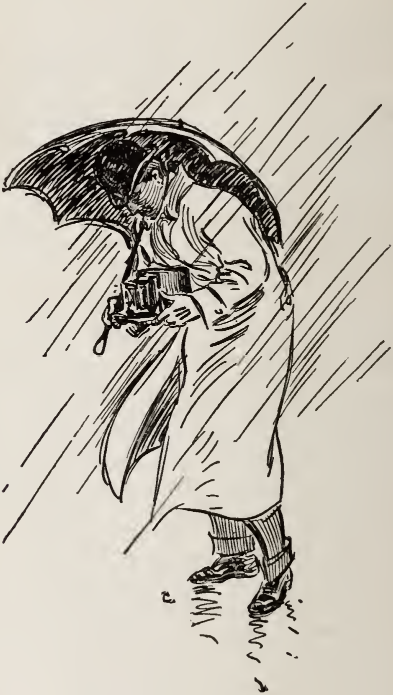
All the high-speed plates thus far introduced show a tendency toward flatness, more particularly a lack of body or opacity in the deep blacks. It is therefore advisable to employ a developer rich in reducer such as pyro, hydroquinone, etc.; on the other hand, in order to get the fullest value of an exposure which by necessity was too brief to properly impress the plate, omit bromide from the developer altogether, or use only what is absolutely necessary to keep the unexposed portions of the film perfectly clean and free from veil.

Brief Exposures with Slow Plates

Many photographers, who prefer to use plates of ordinary speed, will doubtless welcome a method of development which will give them the maximum result of their exposures with such plates. The following pyro-soda developer will give the utmost that can be obtained under these conditions. **A.** Pyrogallol, 27 grains; potassium metabisulphite, 5 grains; water, 10 ounces. **B.** Sodium sulphite (cryst.), 150 grains; sodium carbonate, 1 ounce; water, 10 ounces. Here we have no bromide and the proportion of alkaline carbonate to pyrogallol is as high as we dare go. Equal parts of these two solutions will give a soft, well-gradated negative with an exposure not exceeding one half of that demanded with the ordinary pyro-soda formula.

It should be remembered that when we use such a large proportion of carbonate to pyro, the character of the negative inclines to softness, but to compensate for this we get complete detail in the shadows. Should the negative be too soft to yield prints having the desirable amount of vigor, we recommend increasing the amount of pyro by 25 per cent.

In preparing any developer according to one's own ideas for the development of minimum exposures, the point to be borne in mind is that as little bromide and bisulphite or metabisulphite as possible should be used, and as much alkali as possible, with just sufficient sulphite to keep the negative clear and free from fog or stain.



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